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PATENT SPECIFICATION

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(54) FORTIFIED COMPOSITE SHEET AND PROCESS AND APPARATUS FOR MANUFACTURING THE SAME

(71) We, SANYO-KOKUSAKU PULP KABUSHIKI KAISHA, a joint-stock company duly organised under the laws of Japan, of No. 4-5, 1-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention for which we pray that a patent may be granted to us and the clare this invention for which we pray that be described in and by the following statement:—

The present invention relates to fortified composite sheet and process and apparatus for manufacturing the same.

Conventionally, a type of sheet, which is composed of a kraft paper and a woven sheet of thermoplastic flat yarns and bonded to the former, has been available in the market as "fortified paper". This type of sheet has been widely used for sacks as a substitute for those made of multilayered kraft papers because of their excellent strength and resistance to deterioration under humidity conditions.

However, as the manufacturing process of such sheet inevitably involves a weaving process which is in general very low in process efficiency, the disadvantage resulting from low production efficiency reduces the advantage caused by relatively high production efficiency in the bonding operation and this tends to cause an undesirable rise in the manufacturing cost.

It is an object of the present invention to provide a technique for manufacturing the composite sheet of the above-described fortified type having a reduced manufacturing cost.

According to the present invention, there is provided a fortified composite sheet comprising a base strip, a plurality of stretched thermoplastic resin flat strips anchored at prescribed intervals to said base strip, a bonding layer anchoring said flat strips onto said base strip and a unidirectionally drawn thermoplastic resin surface film anchored to said base strip via said bonding layer in a snug and partial surface contact with said flat strips, the arrangement being that the axis of drawing applied to the surface film is transverse to the axes of drawing of the flat strips.

According to another feature of the invention there is provided a process for the manufacture of a fortified composite sheet which method comprises continuously supplying a surface film formed from a unidirectionally drawn thermoplastic resin, continuously depositing flat strips formed of stretched thermoplastic material on said surface film at prescribed intervals in such a manner that the axis of drawing of said surface film and the axes of drawing of said flat strips are transverse to each other, continuously supplying a base strip concurrently with the supply of said surface film, continuously covering the surface of said base strip with a bonding layer, melt bonding said surface film to said base strip to form a single composite sheet in such a manner that said flat strips and said bonding layer are sandwiched between the surface strip and the base strip, and applying pressure to the planar surfaces of said composite sheet and solidifying said bonding layer.

Thus the composite sheet configuration in accordance with the invention is so designed that the axis of drawing applied to the surface film intersects the axis of drawing applied to the flat strips.

In the manufacturing of sheet, the surface film is continuously supplied to a cooling roller and, on the supply course of same to the roller, the flat strips are deposited by a feeding mechanism onto the surface of the surface film at prescribed intervals in such a manner that the drawing axis of the surface film intersects the drawing axes of the flat strips. Concurrently with this, the base strip is continuously supplied

to a press roller confronting the cooling roller and, on the course of the supply, a bonding material is coated on the surface of the base strip. Finally the four components, i.e. the surface film, the flat strips, the base strip and the bonding material are pressed together by the nip between the two rollers.

Following is a description by way of example only with reference to the accompanying drawings of methods of carrying the invention into effect.

In the drawings:—

Figure 1 is a perspective view of the composite sheet of the present invention;

Figure 2 is a cross sectional view taken along the section line C-C' shown in Figure 1, and

Figure 3 is a side view of an arrangement for manufacturing same.

One embodiment of the fortified composite sheet according to one aspect of the present invention is shown in Figures 1 and 2, in which the fortified composite sheet 1 is composed of a base strip 2, a plurality of flat strips 3 adhered to the base strip 2 via an intermediate bonding layer 4 and extended in the longitudinal direction of the composite sheet 1 and a surface film 6 layered on the upper surfaces of the bonding layer 4 and the flat strips 3.

The base strip 2 is made of such material as papers, cloths and metal foils. The intermediate bonding layer 4 is made of such material as melted low density polyethylenes, melted polypropylenes, other hot-melt bonding agents and pressure sensitive bonding agents.

The flat strips 3 are embedded within the intermediate bonding layer 4 with their upper surfaces being flush with those of the bonding layer 4 between portions of the bonding layer 4 between neighbouring flat strips 3. The flat strips 3 are arranged substantially parallel to each other at prescribed, more preferably at equal, intervals.

The flat strips 3 and the surface film 6 are both made of such thermoplastic resins as crystalline polypropylenes, high density polyethylenes and polyethylene terephthalates.

Combination of the flat strips 3 with the surface film 6 in the configuration of the fortified composite sheet 1 according to the present invention should preferably be so designed that the axis of drawing applied along the longitudinal direction of flat strips 3 crosses substantially at right angles the axis of drawing applied to the surface film 6. In other words, the drawing axis of the flat strips 3 preferably intersects substantially perpendicularly with the drawing axis of the surface film 6. For example, in the configuration of the illustrated fortified composite sheet, when the drawing axis of the surface film 6 runs in the direction of an arrow A, the drawing axes of the flat strips 3 should run in the direction of an arrow B. On the contrary, when the drawing axis of the surface film 6 runs in the direction of the arrow B, the drawing axes of the flat strips 3 should run in the direction of the arrow A.

It should be understood that the undersurface of the surface film 6 is in a snug surface contact with the upper surfaces of the flat strips 3 but they are not bonded to each other. The flat strips 3 are anchored to the base strip 2 via the intermediate bonding layer 4 and the surface film 6 is anchored to the base strip 2, quite independently of each other.

Beneath the surface film 6, the percent ratio of the total area of the flat strips 3 with respect to the total interval area of the flat strips 3 should preferably be in a range from 30 to 70. When the percent ratio exceeds this upper limit value, there will result too poor anchoring of the surface film 6 to the base strip 2. Whereas, the percent ratio below this lower limit value will result poor balanced effect to be caused by the above-described intersection of the drawing axes and less textile feeling of the obtained fortified composite sheet.

An embodiment of the process for manufacturing the fortified composite sheets of the above-described configuration is shown in Figure 3, in which the base strip 2 is supplied to a pressure roller 7 from a given supply source (not shown). Concurrently with this, the surface film 6 is supplied to a cooling roller 8 from a given supply source (not shown). At a position whereat the surface film 6 on the cooling roller 8 meets the base strip 2 on the pressure roller 7, there is provided an overhead extrusion die 9 from which the bonding material is supplied onto the surface film 6 and the base strip 2.

At a position on the side of the cooling roller 8 somewhat upstream of the meeting position of the surface film 6 with the base strip 2, a feeding mechanism 11 of the flat strips 3 is provided above the running path of the surface film 6. As already explained, the flat strips 3 must be arranged on the base strip 2 at prescribed intervals. In order to effect this, the feeding mechanism 11 includes a pair of upper and lower holding devices 12*a* and 12*b* which, on both ends of the flat strips 3 along the direction of running course thereof, hold the flat strips 3. The flat strips 3 supplied to the feeding mechanism 11 at prescribed intervals from an upstreamly located given supply source (not shown) are transported towards the surface film 6, while maintaining their given intervals, as the holding

devices 12*a*, 12*b* circulate. At the downstream terminal of the feeding mechanism 11, the flat strips 3 are one by one released from the ends nip by the holding devices 12*a* and 12*b* and placed on the surface film 6 at prescribed intervals.

Thus the surface film 6 runs towards the meeting position with the base strip 2 while carrying the flat strips 3 thereon at the prescribed intervals. Upon arrival at the meeting position, the bonding material is supplied to the three components 2, 3 and 6 and they are nipped under pressure in between the two rollers 7 and 8.

During the travel in contact around the cooling roller 8, the bonding material is cooled down into a solid state by the cooling roller 8, and forms the intermediate bonding layer 4 (see Figure 2).

After sufficient solidification of the bonding material, the composite sheet 1 is delivered from the cooling roller 8 being guided by a guide roller 13.

As a substitute for the extrusion die 9 used in the illustrated embodiment, a curtain flow coating head or a roll coater can be used especially for hot melt resin bonding agents or pressure responsive bonding agents.

When necessary, the running speed of the feeding mechanism 11 may be designed variable so that the intervals between the neighbouring flat strips 3 on the surface film 6 can be changed freely.

It is also employable that the flat strips 3 are supplied to the feeding mechanism 11 in the form of a continuous elongated sheet having transversal dotted cutting lines at intervals equal to the width of the flat strips, i.e. the dimension of the flat strips 3 in the longitudinal direction of the composite sheet 1. In this case, the feeding mechanism 11 may be provided with a device for tearing the flat strips along the transversal dotted cutting lines off the continuous elongated sheet. This tearing should be carried out at prescribed time intervals. The torn flat strips 3 are held and transported downstream towards the surface film 6 by the travel of the holding devices 12*a* and 12*b* as in the foregoing case.

The following example is illustrative of the present invention, but it is not to be construed as limiting same.

Example

Using the arrangement substantially similar to that shown in Figure 3, a high density polyethylene film of 16 microns thickness, which was drawn laterally, was used as the surface film 6 whereas high density polyethylene flat yarns of 1000 denier thickness and 3.5 mm. width was used as the flat strips 3, drawing of the flat yarns being applied in the lengthwise direction thereof. The flat strips 3 so prepared were deposited one by one on the surface film 6 at about 5 mm. intervals along the running direction of the latter. A Kraft paper of 70g/m² density was used as the base strip 2 with low density polyethylene of 290°C temperature as the bonding material. Supply of the bonding material was carried out by the extrusion system. The thickness of the bonding layer was 30 microns and the density of the obtained sheet 1 was 119.5 g/m².

As the control, a conventional composite sheet composed of a mono-axially drawn high density polyethylene woven cloth bonded to a Kraft paper strip of 70g/m² via low density polyethylene was used. Comparison of functional test results applied to them is given in the following table.

	Invention product	*Conventional product*
Basis Weight, g/m²	119.5	130
Longitudinal tensile strength, Kg/5cm	39.2	33.4
Lateral tensile strength, Kg/5cm	38.8	26.7
Longitudinal tearing strength Kg	2.37	1.79
Lateral tearing strength, Kg	1.38	2.47

The figures are each given in the form of an average of five times testings.

The textile used in the testing was of a structure in which the warp density was 4 yarns/inch, each yarn being of 950 denier thickness, the weft density was 3.5 yarns/inch, each yarn being of 950 denier thickness and the density of the composite sheet was 130 g/m².

As is clear from the foregoing description, employment of the present invention assures the following advantages.

(1) In the configuration of the obtained composite sheet, the surface film is kept in a snug surface contact with the flat strips but not fixedly bonded thereto. Therefore, when the composite sheet is strained due to application of some external force, a slight slippage may occur between the surface film and the flat strips. Thanks to this relatively loose combination of the two components, the obtained composite sheet has less stiffness when compared with the conventional composite sheets and its rich flexibility assures textile feeling.

(2) The surface film and the flat strips are so arranged in the configuration of the composite sheet that the directions of drawings applied to them intersect each other. This intersecting combination of the drawing axes assures balanced strength of the product obtained. That is, the product has

well balanced strengths in the longitudinal and transversal directions thereof.

WHAT WE CLAIM IS:

1. A fortified composite sheet comprising a base strip, a plurality of stretched thermoplastic resin flat strips anchored at prescribed intervals to said base strip, a bonding layer anchoring said flat strips onto said base strip and a unidirectionally drawn thermoplastic resin surface film anchored to said base strip via said bonding layer in a snug and partial surface contact with said flat strips, the arrangement being that the axis of drawing applied to the surface film is transverse to the axes of drawing of the flat strips.

2. A sheet as claimed in claim 1 in which said axis of drawing applied to said surface film intersects substantially at right angles with respect to the axes of drawing applied to said flat strips.

3. A sheet as claimed in claim 1 or claim 2 in which said axis of drawing applied to said surface film is substantially perpendicular to the longitudinal direction of said fortified composite sheet.

4. A sheet as claimed in any preceding claim in which said flat strips are spaced apart from each other at prescribed intervals in the lateral direction of said fortified composite sheet.

5. A sheet as claimed in any preceding claim in which said flat strips are uniformly spaced apart.

6. A sheet as claimed in any preceding claim in which the percent ratio of the total area of said flat strips with respect to the total interval area of said flat strips is in a range of 30 to 70.

7. A sheet as claimed in any preceding claim in which said base strip comprises one or more of paper, fabric and metal foil.

8. A sheet as claimed in any preceding claim in which said flat strips comprise one or more of crystalline polypropylene, high density polyethylene and polyethylene terephthalate.

9. A sheet as claimed in any preceding claim in which said surface film is formed of one or more of crystalline polypropylene, high density polyethylene and polyethylene terephthalate.

10. A sheet as claimed in any preceding claim in which said bonding layer comprises one or more of melted low density polyethylenes, melted polypropylenes, other hot melt bonding agents and pressure sensitive bonding agents.

11. A fortified sheet material substantially as herein described with reference to and as illustrated in Figures 1 to 3 of the accompanying drawings.

12. Process for the manufacture of a fortified composite sheet which method comprises continuously supplying a surface film formed from a unidirectionally drawn thermoplastic resin, continuously depositing flat strips formed of stretched thermoplastic material on said surface film at prescribed intervals in such a manner that the axis of drawing of said surface film and the axes of drawing of said flat strips are transverse to each other, continuously supplying base strip concurrently with the supply of said surface film, continuously covering the surface of said base strip with a bonding layer, melt bonding said surface film to said base strip to form a single composite sheet in such a manner that said flat strips and said bonding layer are sandwiched between the surface strip and the base strip, and applying pressure to the planar surfaces of said composite sheet and solidifying said bonding layer.

13. A process as claimed in claim 12 wherein the sheet is formed on apparatus comprising means for continuously supplying said surface film, a feeding mechanism located over said surface film supplying means for supplying said flat strips onto said surface film at prescribed intervals, means for continuously supplying said base strip, means for covering said base strip with said bonding layer and means for making said surface film meet with said base strip under pressure with said flat strips and said bondnig layer being sandwiched between them.

14. A process for the manufacture of a fortified composite sheet substantially as herein described with reference to the accompanying drawings.

15. Apparatus for use in the process claimed in claim 12 which apparatus comprises means for continuously supplying said surface film, a feed mechanism disposed over said surface film supplying means adapted to supply said flat strips thereon at prescribed intervals, means for continuously supplying said base strip, means for applying said bonding layer to the base strip, and means for supplying pressure to the composite of surface film, flat strips and base strip for forming a laminate thereof.

16. Apparatus for use in the process as claimed in claim 12 and substantially as herein described with reference to and as illustrated in Figure 3 of the accompanying drawings.

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1473619 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG. 1

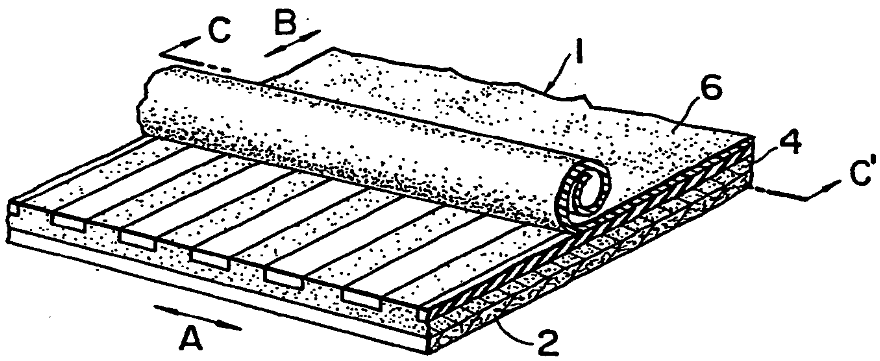


FIG. 2

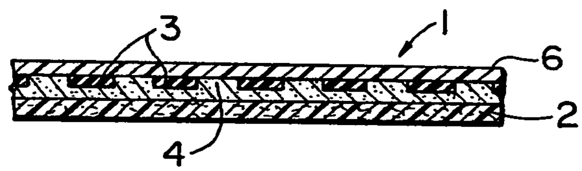
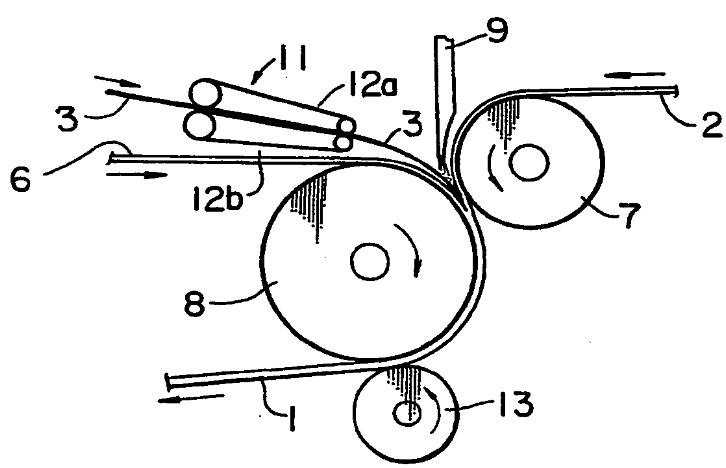


FIG. 3



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